Grinding apparatus for treatment of a surface

Field of the Invention

The present invention concerns a grinding apparatus for processing a workpiece, including a support arrangement for a number of grinding heads that each includes a grinding element and a grinding motor driving an associated grinding element.

Background of the Invention

By industrial grinding or sanding of items that include edges, roundings and surfaces, e.g. table tops, different types of grinding apparatuses are used which may grind the entire item in one run through the grinding apparatus. In order to achieve a nice surface, it is important that the grinding apparatus does not leave any distinct marks coming from the direction of grinding or sanding.

There are e.g. grinding apparatuses with a number of rollers, either with surrounding sandpaper or with a number of grinding elements that are disposed in the longitudinal direction of the roller.

In order to avoid that the directions of grinding of the rollers are the same, the grinding apparatus is designed either with rollers typically rotating opposite each other, or rollers set at different angles in relation to the surface.

The disadvantage of these types of rollers is that they consume a large amount of sandpaper, whereby the sandpaper is to be replaced often. This causes stop in production and increases the costs of grinding.

Furthermore, the grinding apparatus will not be worn evenly along the roller, in particular if items with different dimensions are to be ground. Typically, the sandpaper will be worn most at the centre part of the roller.

In WO 99/22905 and EP 0 471 641 there is described another kind of grinding apparatus where a number of rotating rollers are disposed about a vertical shaft connected to

a drive unit, so that the rollers, besides rotating about their own shaft, rotate in the horizontal plane about the vertical shaft.

By rotating the shaft about two shafts, it is attempted to avoid distinct grinding marks. In WO 99/22905, the rollers are rotating in mutually different directions with different speeds.

The disadvantage of this is that the rotating rollers with direction of rotation opposite the rotation in the horizontal plane will have greater grinding effect than the rollers having direction of rotation in the same direction as the rotation in the horizontal plane.

In EP 0 471 641 are used a number of grinding arrangements where each grinding arrangement consists of a number of rotating rollers rotating about a vertical shaft. In order to ensure grinding of the entire item, these grinding arrangements are arranged with overlap, causing uneven grinding, since there are areas of the item which are ground more than once.

The disadvantage of both the above grinding apparatuses is that they, in order to grind broad items, are to have long rollers, implying that the motor units for these rollers are to be correspondingly larger. This results in a large capital cost for the grinding apparatus and a greater energy consumption.

In US 2002/0068515 there is described a surface processing apparatus, where either a bar with a grinding drum and/or a bar with a number of circular grinding brushes are used for surface processing a preferably flat item, and where the grinding brushes are shown arranged in two rows, mutually displaced so that the grinding area of the second row of grinding brushes just overlap the grinding area of the first row of grinding brushes.

This construction of a surface treatment apparatus entails non-uniform surface treatment, since the grinding areas of the two rows of grinding brushes overlap each other, whereby only one grinding of the surface of the item occurs.

This means that the apparatus will not ensure an efficient grinding/deburring of edges and roundings of an item, as e.g. a stationary grinding drum may only grind the surface and forward facing edges/roundings, and a bar with overlapping grinding area of the grinding brushes only ensures a grinding of large parts of the surface once.

Object of the Invention

It is the purpose of the invention to indicate a grinding apparatus which is simple in structure, and which by means of a number of movable grinding elements may uniformly cross-grind an item or workpiece with edges, roundings and burrs, simultaneously with the consumption of sandpaper is minimal.

This is achieved by means of a grinding apparatus as specified in the preamble of claim 1, and where the support arrangement includes an endless conveying means for the grinding heads, the conveyor means being moved in an annular course by at least one moving motor for establishing an epicyclic movement of the grinding elements across the work piece during operation.

Description of the Invention

In order to grind an item in one run through the grinding apparatus, it is designed with a number of grinding elements driven by the grinding motors and which constitute a number of grinding heads.

These grinding heads are connected with a support arrangement that holds the grinding heads at a desired position in relation to the surface of the item.

In a preferred embodiment of the invention, these grinding elements are circular grinding wheels connected to the grinding motors so that they are disposed in the horizontal plane and preferably in parallel with the surface of the workpiece to be ground.

In order to grind the whole item in one run, the support arrangement includes a conveying means for the grinding heads, the conveying means being driven by the moving motors.

This entails that the individual grinding elements, besides that they may rotate about their own vertical shaft, may move horizontally transversely of the workpiece in a direction perpendicular to the vertical shaft of the grinding elements. This will ensure that the whole workpiece is ground in one run through the grinding apparatus, as the grinding elements perform an epicyclic movement across the workpiece.

In a preferred embodiment of the invention, the conveying means is an endless course providing that the grinding heads are moved in an annular path around from one side to the opposite side and back again to the first side, so that the item is surface treated by two rows of grinding heads in one run through the apparatus.

In that way is achieved a very even grinding of the item, since the second row of grinding heads will typically grind in opposite direction and thereby even possible irregularities appearing by the grinding made by the first row of grinding heads, whereby an edge of an item will typically be ground by minimum two grinding heads.

In an embodiment of the invention, the grinding elements are connected to the grinding motors with a fixed shaft, whereby items with uniform thickness may be ground/sanded on the top side face, as the sandpaper on all grinding elements is parallel with the surface.

In a second embodiment of the invention, the grinding elements are connected to the grinding motors with a movable shaft, e.g. a universal shaft or a shaft with a ball joint/bowl joint, whereby workpieces/items with non-uniform thickness may be ground on the top side face, since the sandpaper may now follow the contour of the surface of the item.

In order to improve the grinding and to avoid uneven grinding of the item, eacht grinding head includes a grinding element with associated grinding motor, whereby it is possible to have different direction of rotation for each single grinding element.

For example:

- every other grinding head may have the same direction of rotation of the grinding element, while the intermediate grinding heads have opposite direction of rotation, or
- every third grinding head may have the same direction of rotation of the grinding element, while the intermediate grinding heads have opposite directions of rotation.

The different directions of rotation of subsequent grinding elements cause that the grinding apparatus advantageously may be used in deburring and grinding edges and roundings. The lateral movement of the grinding heads furthermore entails that an epicyclic movement is effected across the workpiece, providing a more efficient grinding of the edges and roundings of the item.

The lateral movement of the grinding heads is to be adjusted to the speed with which the item is moved through the grinding apparatus, so that the grinding heads are moved at least so fast that the item is provided at least two grinding actions, and that there are no areas on the item which are not ground.

In order to move the grinding heads transversely of the feeding direction of the item, the conveying means is constituted by a number of drive chains or belts which are adapted for engaging a drive wheel driven by the moving motors.

In a preferred embodiment of the invention, four of these drive wheels are disposed rectangularly in the support frame, so that grinding heads connected to the conveying means are moved transversely of the item at first, and then back transversely of the item.

If the conveying means is a drive chain, the drive wheel will be sprocket wheels engaging the drive chain and thereby driving the conveying means with grinding heads.

If the conveying means is a drive belt in the shape of a V-belt, the drive wheels will either be smooth drive wheels which by means of the resisting force between V-belt

and drive wheel will drive the conveying means with grinding heads around, or be a toothed drive wheel that engage a toothed side of the V-belt.

Alternatively, the conveying means may be wires or wide bands or similar where the drive wheel is a narrow drive wheel or a roller, respectively.

Instead of having the drive wheels set up rectangularly in the support frame, the drive wheels may be envisaged set up in other polygonal arrangements, as for example:

- three drive wheels disposed as a triangle, or
- five drive wheels disposed as a pentagon.

Alternatively, there may only be used two drive wheels which the conveying means are running around, so that the two rows of grinding heads are disposed in immediate succession. This puts demands on the grinding elements for not having too great diameter, since the grinding heads cannot pass each other transversely of the item.

It would be advantageous if the two rows of grinding heads are moving transversely of the item at a certain distance, since there will be time and room for abraded material from the first row of grinding heads to be removed from the item and thus not prevent the second row of grinding heads from performing an optimal grinding.

Instead of having drive wheels that are connected to a moving motor in every corner of the support frame, some of these drive wheels may be idlers which are only provided for guiding the conveying means.

In a preferred embodiment of the invention, the conveying means is a wide toothed belt running on two large sprocket wheels disposed with one sprocket wheel at each side of the grinding apparatus. The grinding heads are disposed on the toothed belt.

Since a grinding apparatus is to be used on items with different thickness or for items with varying thickness, it includes an apparatus frame in which the support arrangement is adjustable in height, arranged by means of a number of displacing force providers.

As the support frame with grinding heads has a considerable weight, a number of displacing force providers are applied for elevating/lowering the support frame in the apparatus frame.

This implies that the support frame may be disposed at a set level in the apparatus frame, whereby the grinding elements may be disposed so that they grind a precise thickness of the item.

The displacing force providers may be cylinders, rack and pinion arrangements, mechanical rocker arrangements, rotational arrangements or similar, which may be driven hydrulically, pneumatically or electrically.

The fact that the support frame can be adjusted in height makes it easy to bring the support frame up at a level which is readily accessible for replacing the grinding elements.

The grinding elements may be constituted by:

- grinding discs that are mounted on a grinding wheel, e.g. by means of Velcro faces, or
- grinding wheels that are formed with a pin which is connected to the shaft of the grinding motors, e.g. by a screw socket.

In these ways grinding elements may be readily replaced so that it is not required with long productions interruptions when grinding elements are to be changed.

Furthermore, the grinding heads may have grinding elements with different members, as e.g. sandpaper, grinding brushes, wire brushes, polishing cloths or brushes.

A grinding apparatus according to the present invention may find application in the wood industry, but may also find application with other industries where there are surfaces to be ground, e.g. in the automobile industry where sheet parts for vehicles are to be ground.

Short Description of the Drawing

The invention will now be described further with reference to the accompanying drawing, where:

Fig. 1 shows a perspective view of a grinding apparatus according to the invention,

Fig. 2 shows a sectional view of the grinding apparatus in Fig. 1,

Fig. 3 shows a side view of the grinding apparatus in Fig. 1,

Fig. 4 shows an additional side view of the grinding apparatus in Fig. 1,

Fig. 5 shows a grinding head,

Fig. 6 shows an alternative support frame, and

Fig. 7 shows a set-up of a grinding apparatus.

Detailed Description of the Invention

On Figs. 1-4 is shown a grinding apparatus 1 that includes a number of grinding heads 6 which are constituted by a grinding motor 3 and grinding element 2.

Each grinding head 6 is suspended in the support frame 4 along a conveying means 9 with a sheet part 14.

Conveying means 9 is adapted for engaging drive wheels 11 that are driven by moving motors 5.

In the shown embodiment of the grinding apparatus 1 there are two drive wheels 11 and two idlers 10 disposed in a rectangle so that the grinding heads 6 are moved perpendicularly and transversely of the feeding direction A of a workpiece or item (not shown). Drive wheels 11 are disposed at opposite corners of the support frame 4.

The conveying means 9 is shown as two chains engaging an upper and a lower set of drive wheels 11a, 11b/idlers 10a, 10b, respectively, which are shown as sprocket wheels.

In order to keep the grinding heads 6 in a vertical position so that the grinding elements 2 are paralllel with the surface of the item (not shown), the apparatus frame 7 is provided with a wire/a belt 13 that prevents the grinding heads 6 from lateral deflections.

The support frame 4 is connected with the apparatus frame 7 via drive wheels 11/idlers 10 and frame part 15, and is adjustable in height by means of cylinder 12.

Fig. 5 shows a grinding head 6 including a grinding element 2 which is drivingly connected to a grinding motor 3 and suspended in a plate element 21 which constitutes the connection between the grinding head 6 and the support frame (not shown).

Fig. 6 shows an alternative support frame 4 on which a number of grinding heads 6 are arranged on a continuous conveying means 9, shown here as a broad toothed belt. The continuous conveying means 9 is drivingly connected with a moving motor 5 so that the grinding heads 6 may be moved around on the support frame 4, simultaneously with the grinding elements 2 being rotated by means of the grinding motors 3, whereby an epicyclic movement of the individual grinding elements 2 is established.

Fig. 7 shows a set-up of two grinding apparatuses 22, 23 in apparatus frame 7, where a first grinding apparatus 22 is arranged so that the grinding elements 2 are in contact with a surface of an item 20 which is moved across a roller table 24. A second grinding apparatus 23 is so arranged in the apparatus frame that the grinding elements 2 are in contact with an underside of the item 20 while it is moved from roller table 24 to roller table 25. Both grinding apparatuses 22, 23 are arranged adjustable in height in the apparatus frame 7 by means of cylinders 12. By the shown arrangement in Fig. 7, it is possible to treat the surface of an item 20 on both sides in one run.